Remarks

Applicants respectfully request reconsideration of the present application in view of the foregoing amendments and the following remarks. Claims 1-20 are pending in the application. Claims 1-20 are rejected. No claims have been allowed. Claims 1, 13 and 18 are independent. Editorial amendments have been made to claims 1-13 and 18. No new matter has been added.

Cited Art

The Action cites U.S. Pat. App. Pub. No. US 2002/0120428 to Christiaens. ("Christiaens").

Rejections Under 35 U.S.C. § 101

The Action objects to claims 1-20 under 35 U.S.C. § 101 for allegedly being directed to non-statutory subject matter. In one instance, the Action alleges that claims 1-12 are directed to "functional descriptive material." [Action, at page 2 § 7.] The Action also alleges that "[s]uch claimed computer programs do not define any structural and functional interrelationships between the computer program and other claimed elements of a computer which permit the computer program's functionality to be realized." [*Id.*]

Applicants have amended claim 1 to more clearly recite language demonstrating relationships between the system of claim 1 and a computer. Specifically, claim 1 now recites "[a] computer comprising one or more computer-readable media and a processor, the computer-readable media containing instructions, which, when executed by the processor on the computer, cause the computer to perform the actions of" the system recited in claim 1. As such, claim 1, as well as claims 2-12, which each depend from claim 1, recite statutory subject matter and Applicants request that the rejection of claims 1-12 be withdrawn.

The Action also rejects claims 13-20 under 35 U.S.C. § 101, alleging that the claims are not directed to a "practical application" because the "final result" is not "useful, tangible, and concrete." [Action, at pages 2-3, § 8.] In particular, the Action focuses on the language "such that if the assertions are not met, the presence of a data race. . . is indicated" as the improper "final result." [*Id.*]

Applicants note, however, that both the methods recited in claims 13-17 and of the instructions recited in claims 18-20 result in the creation of "a sequential program from the concurrent program." Applicants also note that the particular "such that" language quoted as part of the rejection is, in actuality, language which describes the sequential program produced as part of the claims. Notwithstanding the Action's reading of this "such that" language, claims 13-20 each produce a "sequential program," and, as such, produce a concrete, tangible, and useful result.

Finally, in response to the Action's argument that claims 18-20 cover "communication media," Claims 18-20 are amended herein to clarify that the claimed media is a storage media. Further, the paragraph of the specification that characterized computer-readable media to possibly include communication media is deleted. With this amendment, claim 18, as well as dependent claims 19-20, recite statutory subject matter. Applicants request that the rejection of claims 18-20, as well as the rejection of claims 13-17 be withdrawn.

Rejections Under 35 U.S.C. § 112

The Action rejects claims 1-20 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The Action rejects the claims as "being incomplete for omitting essential elements/steps." [Action, at page 3, § 11.] Specifically, with regard to independent claim 1, the Action alleges that "the omitted steps are: how the assertions cause an error message to be produced. [*Id.*] Applicants note, however, that claim 1 has been amended to recite: "when the sequential program is analyzed by a program analyzer, the assertions cause an error message to be produced by the program analyzer when the concurrent program contains a data race." Applicants believe that, with the amendments, claim 1 satisfies the requirements of 35 U.S.C. § 112. As such, the rejection of claim 1, as well as the rejections of dependent claims 2-12, should with withdrawn.

With regard to independent claim 13, the Action alleges that "how the presence of a data race in the concurrent program for the target variable is indicated." Additionally, with regard to independent claim 18, the Action alleges that "how the presence of an error in the concurrent program is indicated." [*Id.*] Applicants note, however, that claims 13 and 18 have been amended. Claim 13 now recites: "that, during an analysis of the sequential program, when the

assertions are not met, the analysis of the sequential program indicates the presence of a data race in the concurrent program for the target variable." Claim 18 now recites: "that, during an analysis of the sequential program, when the assertions are not met, the analysis of the sequential program indicates the presence of an error in the concurrent program." Applicants believe that, with the amendments, claims 13 and 18 satisfy the requirements of 35 U.S.C. § 112. As such, the rejections of claims 13 and 18, as well as the rejections of dependent claims 14-17, 19, and 20, should with withdrawn.

The Action also specifically rejects claims 5, 13, and 18 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In particular, the Action alleges that claims 13 and 18 are indefinite for having an "alternative condition and results." [*Id.*, at page 4, § 12.] Applicants note, however, that claims 13 and 18 have been amended to recite "*when* the assertions are not met, ..." Applicants believe that, with the amendments, claims 13 and 18 satisfy the requirements of 35 U.S.C. § 112. As such, the rejections of claims 13 and 18 should with withdrawn.

With respect to claim 5, the Action alleges that the claim is indefinite because of "insufficient antecedent basis" for the claim language "the analyzed variable" in line 5. Additionally, the Action alleges that the language "the variable" at the end of claim 5 is "ambiguity." [*Id.*] Both parts of claim 5 are now amended to recite "the analyzed target variable." Applicants believe that, with the amendments, claim 5 satisfies the requirements of 35 U.S.C. § 112. As such, the rejection of claim 5 should with withdrawn.

Rejections Under 35 U.S.C. § 102

Claims 1-20 are rejected under 35 USC 102(b) as being anticipated by Christaens. Applicants respectfully disagree and traverse the rejection. For a 102(b) rejection to be proper, the cited art must show each and every element as set forth in a claim. (*See* MPEP § 2131.01.) However, the cited art does not describe each and every element. Accordingly, applicants request that the rejection be withdrawn. Claims 1, 13, and 18 are independent.

Claim 1

Claim 1 recites:

> a program sequentializer module configured to accept a concurrent program as input and create as output a sequential program having assertions;

The application, at page 6, describes a sequential program as output of a sequentializer module:

> In the illustrated embodiment, a concurrent program 220, containing multiple threads 225 is received by the sequentializer in order that it may be analyzed. In the illustrated embodiment, the sequentializer 200, upon receiving the concurrent program 220, creates *a sequential program 230 containing a single thread 235*.

[Application, at page 6, lines 17-20; emphasis added.] Thus, one utility of the sequentializing module is not simply to add assertions, *but to create a sequential program with a single thread* as well. One goal of creating sequential programs is discussed in the "Locating Data Races" section of the Application:

> [B]ecause the execution time of such an analysis grows exponentially with the number of threads in the concurrent program, *the time required to perform [analysis on a multithreaded program] can be prohibitively expensive. In certain circumstances, such an analysis may never complete;* it has been proven that the general problem of detecting data races in multithreaded programs is undecideable. That is, no program can exist which can correctly identify every data race in every concurrent program in a finite period of time.
>
> *In contrast, analysis on single-threaded, or sequential, programs has been shown to be decideable.* Thus a number of existing products have been developed and optimized to perform static analysis on sequential programs. . . . While these optimized tools would be useful for data race checking, they have traditionally not been helpful to programmers of concurrent systems because of the undecidability and time-cost of analyzing concurrent programs. *What is needed is a system that would allow developers of concurrent programs to take advantage of the efficiency of existing sequential analysis tools when searching for data races.*

[Application, at page 3, line 16 to page 4, line 4.]

The cited sections of Christiaens do not describe, teach, or suggest "a program sequentializer module configured to accept a concurrent program as input and create as output a sequential program." In its rejection of the above-quoted language of claim 1, the Action cites to Figures 17a and 17b, as well as paragraphs 0246-247 and 0255-0261 of Christiaens. [*See*, Action, at page 5, § 14.] Parts of these sections describe instrumentation of objects [*See, e.g.*, Christiaens, at page 13, paragraph 247.] and bytecode [*See, e.g.*, Christiaens, at page 13

paragraph 255.] but do not describe the creation of a sequential program from a concurrent program. Christiaens *does* describe the use of a compiler at paragraphs 0256-0261 on pages 13-14, but again, does not describe, as part of this compilation, the creation of any sequential program from a concurrent program. Additionally, the two Figures cited in the rejection do not describe at all the creation of a "sequential program." At best, Figure 17a describes "executable code 1702." However, no indication is given that this is a sequential or single-threaded program.

In fact, as Christiaens is explicitly designed to be analyze multi-threaded programs during multi-threaded execution, Chrisiaens is not designed to be used with, and does not suggest usage of, a sequential or single-threaded program. Christiaens is directed to:

> A computer implemented method for detecting data races in the execution of multi-threaded, strictly object oriented programs is provided, whereby *objects on a heap are classified in a set of global objects, containing objects that can be reached by more than one thread,* and sets of local objects, containing objects that can only be reached by one thread.

[Christiaens, at Abstract; emphasis added.] Thus, in Christiaens broadest description, it takes for granted that, during analysis, *more than one thread will exist*. Analysis on multiple threads is antithetical to the use of a sequentializer module such as that recited in claim 1.

Furthermore, the cited sections of Christiaens rely on the use of "vector clocks" or "accordion clocks," "which are an advanced version of vector clocks." [*E.g.*, Christiaens, at page 13, paragraphs 0246 and 0255 and page 14, paragraph 0259.] However, the use of vector clocks relies on the existence of multiple threads during analysis:

> *Vector clocks are used in distributed systems* to determine whether pairs of events are causally related. Timestamps are generated for each event in the system, and a causal relationship is determined by comparing these timestamps. Each process assigns a timestamp to each event. *Vector clocks are tuples of integers with a dimension equal to the maximum degree of parallelism (number of threads) in the application.* In a system made up of n processes (n threads), each process keeps a vector clock with n slots.

[Christiaens, at page 7, paragraph 0123; emphasis added.] Thus, vector clocks, which are relied upon in the cited passages of Christiaens, assume the existence of multiple threads for their utility. For at least these reasons, Christiaens' system and techniques not only do not describe the use of a sequentializer or the creation of a sequential program, but are so directed to rely the existence of multiple threads for their performance that Christiaens likely *cannot* teach or

suggest "a program sequentializer module configured to accept a concurrent program as input and create as output a sequential program," as recited in claim 1.

For at least these reasons, Christiaens does not describe, teach, or suggest each and every element of claim 1. Additionally, each of claims 2-12, which depend from claim 1, recite additional patentable language. Thus, Applicants respectfully note that claim 1 and its dependent claims 2-12 are allowable and request the allowance of claims 1-12.

Claim 13

Claim 13, as amended, recites:

> *creating a sequential program from the concurrent program*, the sequential program containing assertions such that, during an analysis of the sequential program, when the assertions are not met, the analysis of the sequential program indicates the presence of a data race in the concurrent program for the target variable.

The Action rejects claim 13 (and claims 14-17) over identical reasons as in the rejections of claims 1-12 and without specifying to which claims previously-cited passages apply. [*See*, Action, at page 9, § 14.] Thus, noting the similarity of the language quoted herein to the language quoted above for claim 1, Applicants respectfully assert that, for at least the reasons discussed above, Christiaens does not describe, teach, or suggest each and every element of claim 13. Additionally, each of claims 14-17, which depend from claim 13, recite additional patentable language. Thus, Applicants respectfully note that claim 13 and its dependent claims 14-17 are allowable and request the allowance of claims 13-17.

Claim 18

Claim 18, as amended, recites:

> create a sequential program from the concurrent program, the sequential program containing assertions such that, during an analysis of the sequential program, when the assertions are not met, the analysis of the sequential program indicates the presence of an error in the concurrent program.

The Action rejects claim 18 (and claims 19 and 20) over identical reasons as in the rejections of claims 13-17 and without specifying to which claims previously-cited passages apply. [*See*, Action, at page 9, § 14.] Thus, noting the similarity of the language quoted herein to the language quoted above for claims 1 and 13, Applicants respectfully assert that, for at least

the reasons discussed above, Christiaens does not describe, teach, or suggest each and every element of claim 18. Additionally, each of claims 19 and 20, which depend from claim 18, recite additional patentable language. Thus, Applicants respectfully note that claim 18 and its dependent claims 19 and 20 are allowable and request the allowance of claims 18-20.

Request for Interview

If any issues remain, the Examiner is formally requested to contact the undersigned attorney prior to issuance of the next Office Action in order to arrange a telephonic interview. It is believed that a brief discussion of the merits of the present application may expedite prosecution. Applicants submit the foregoing formal Amendment so that the Examiner may fully evaluate Applicants' position, thereby enabling the interview to be more focused.

This request is being submitted under MPEP § 713.01, which indicates that an interview may be arranged in advance by a written request.

Conclusion

The claims in their present form are allowable. Such action is respectfully requested.

Respectfully submitted,

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